Willow Develops Extensive Root Systems in Acid-Generating Mine Wastes

Adequate root development is crucial to decreasing planting stress when woody species are used to remediate degraded mine soils because roots are in contact with potentially available contaminants in the substrate. However, techniques to improve phytoremediation success rarely take into account root development.

In the November–December issue of the *Journal of Environmental Quality*, researchers study deep root development of fast-growing willows in mine wastes’ profile and trace element accumulation in leaves after covering the wastes with soil varying in thickness (0, 20, and 40 cm of soil).

They found that the tested trees grew roots down to 60 cm in shale waste rocks after three years, even if they were generating acid. When a soil layer thinner than 40 cm was used, it delayed root development in underlying waste rocks for at least one year. Consequently, root system size was smaller. All trees accumulated cadmium and zinc in foliage over time, especially with soil layers.

Despite proven ability to extensively develop roots when planted in the mine wastes, this metal accumulation in parts that can be browsed limits the use of this willow to stabilize the wastes. Moreover, this accumulation could slow down litter decomposition processes and organic matter cycling, which is the starting point of ecosystem development.


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Anthropogenic Legacies Control Soils and Landscapes

Historic charcoal hearths are relics of historic charcoal production near former iron works in Europe and North America. These charcoal hearth remains are typically round to elliptical forms ranging in diameter from 8 to 14 m and consisting of several-decimeter-thick layers that contain charcoal fragments, ash, and burnt soil. Due to their widespread appearance in different regions of the world, charcoal hearth remains provide a unique archive of the long-term interaction between biochar, soil development, and plant growth. Pedological research on historic charcoal hearths is an emerging field that can significantly enhance our understanding of the environmental impact of historical charcoal production on soil and landscapes.

In an article recently published in the *Soil Science Society of America Journal*, researchers studied the soil chemistry of 24 charcoal hearths and compared them with the surrounding “natural” soils in the northern Appalachians of northwestern Connecticut. Hearth remains are situated on hillslopes, often show a multilayered stratigraphy resulting from multiple site usage, and have thick topsoil sequences compared with the surrounding forest soils. Topsoils on the charcoal hearths are also slightly less acidic than the surrounding forest soils.

For a better understanding of the legacy effects of historic charcoal production, the chemical differentiation of soil organic matter and pyrogenic matter will be crucial for future research.


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Schematic representation of substrate treatments tested in the study. (a) Direct planting in waste rocks (W). (b) The 20-cm layer of soil mixed with 20% peat soil above a 20-cm layer of lime sludge (S20LS). (c) The 20-cm layer of soil mixed with 20% peat soil (S2020). (d) The 20-cm layer of soil mixed with 40% peat soil (S2040). (e) The 40-cm layer of soil mixed with 20% peat soil (S4020). AMD, acid mine drainage.